

TGF Radar Rack Overview

and

Interface Control Document

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1. INTRODUCTION

The Target Generation Facility at William J. Hughes Technical Center was developed to provide a simulation test bed for performing Operation Test and Evaluation (OT&E) on new equipment and functions, to refine both current and proposed Air Traffic Control (ATC) systems and concepts, and to verify operational readiness prior to being deployed into the National Airspace System. It provides high fidelity, real-time capabilities necessary to support both OT&E and Research and Development (R&D). Radar Boxes are being used to simulate radar necessary for testing.

1.1 PURPOSE

The TGF Radar Rack Overview and Interface Control Document (ICD) defines the interface between the Target Generator Facility Chassis and radar boxes. This ICD describes the communication interface between these systems.

1.2 ORGANIZATION

The TGF at the Federal Aviation Administration William J. Hughes Technical Center (FAA Technical Center) is managed by the System Simulation Support Branch, ACT-510, of the Aviation Simulation and Human Factors Division, ACT-500.

2. OVERVIEW

The Radar Box (RBX) computers provide the main interface between the Technical Center ATC Laboratories and the TGF. The RBX computers are capable of transmitting radar, receiving radar and performing interfacility (IF) communication. They are used during simulations to provide radar and IF communication between the TGF and the ATC Laboratories. Figure 2-1 shows a general overview of the interface to the RBX.

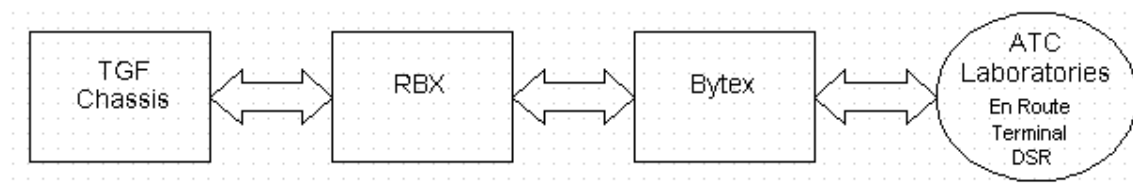


Figure 2-1 General Overview

The remainder of this section will discuss the RBX tasking model, the Exercise Control Operator (ECO) to TGF Interface, the RBX hardware and the RBX software.

The remainder of the document will discuss the protocols of the three interfaces to the RBX.

- RBX Monitor Interface
- Device Access Server
- TGF Server

The RBX monitor interface allows the status of available devices to be queried. The device access server provides the capability of working with the devices on a low level. The TGF server handles all radar data transmission. Table 2-1 provides a list of the packet types that are passed over the network by each of these interfaces.

Table 2-1 RBX Interface Packet Types

RBX Monitor	Device Access Server	TGF Server
Resource Availability	Device Open	TGF Open
Request	Device Open Reply	TGF Open
Reply		
Resource Availability	Device Close	TGF Data
Response	Device Data	TGF Close
	Device IO Control (IOCTL)	TGF Start TGF Stop TGF Pause TGF End of Epoch

2.1 RADAR BOX TASKING MODEL

There are several tasks that run in conjunction with the radar boxes. These processes are the radar box monitor (RBXM), the Device servers, and the TGF server. See Appendix E for the UDP/TCP Port Assignments of the processes that run on the RBX computers. The following is a description of each of these tasks.

2.1.1 Radar Box Monitor

The Radar Box Monitor (RBXM) keeps a record of the status of each device on the RBX computers. When a machine, usually the ECO, requests information regarding the status of the devices, the RBXM gathers the information and sends a reply to the requestor. The RBXM is listening on port 6000 for requests. See section 3 for a complete description of the RBXM interface protocol.

2.1.2 Device Servers

The Device Servers make the RBX devices available over the network. The following are the three types of device servers that run on the RBX.

- Radar Transmitter Device (PRDRTXD)
- Radar Receiver Device (PRDRRXD)
- Interfacility Device (PIFD)

Section 4 provides a complete description of the device access server protocol. The following is a description of these device servers.

2.1.2.1 Radar Transmitter Device

The Pseudo Radar Transmitter Device (PRDRTXD) communicates directly with the radar transmitter devices on the RBX computers and allows other processes to send radar data out of the RBX. A PRDRTXD is invoked by the inetd daemon whenever a request to open a transmitter device is received. The PRDRTXD listens on port 6001.

2.1.2.2 Radar Receiver Device

The Pseudo Radar Receiver Device (PRDRRXD) communicates directly with the radar receiver devices on the RBX computers and allows other processes to receive radar data from any radar source connected to the Bytex including the TGF itself. A PRDRRXD is invoked by the inetd daemon whenever a request to open a receiver device is received. The PRDRRXD listens on port 8000.

2.1.2.3 Interfacility Device

The Pseudo Interfacility Device (PIFD) communicates directly with the IF devices on the RBX computers and allows other processes to conduct IF communications with other entities connected to the Bytex. A PIFD is invoked by the inetd daemon whenever a request to open an IF device is received. The PIFD listens on port 7000.

2.1.3 TGF Server

The TGF Server is responsible for sending data to the RBX computers. It communicates with the Chassis, the PRDRTXD, the PRDRRXD, and the PIFD. The TGF Server passes information between the Chassis and the appropriate device. The TGF Server listens on port 9050 + the Chassis number. Section 5 provides a complete description of the TGF server protocol.

2.2 ECO TO TGF INTERFACE

Initial communication with the RBX computers takes place using an Exercise Control Workstation (ECW). The operator of the ECW, the ECO, is responsible for configuring and starting a simulation. The ECO sends a request to the RBXM to determine which devices are available. The RBXM responds to the request with information on the status of each resource that the RBX computers possess. The ECO then chooses available radar and the TGF Chassis is notified of these choices.

The Core Target Generator (CTG) sends an open request from the Chassis to the RBX TGF Server for each radar selected. The RBX reserves the requested radar so that no other resources can utilize it. Throughout the simulation, the Target Generator Executive (TGE) sends start, pause, and close messages from the Chassis to the RBX. While the simulation is running, the CTG sends radar messages to the RBX continuously. The TGE is responsible for sending an end-of-epoch message to the RBX once every second.

Figure 2-2 presents an architectural overview of the TGF to RBX interface.

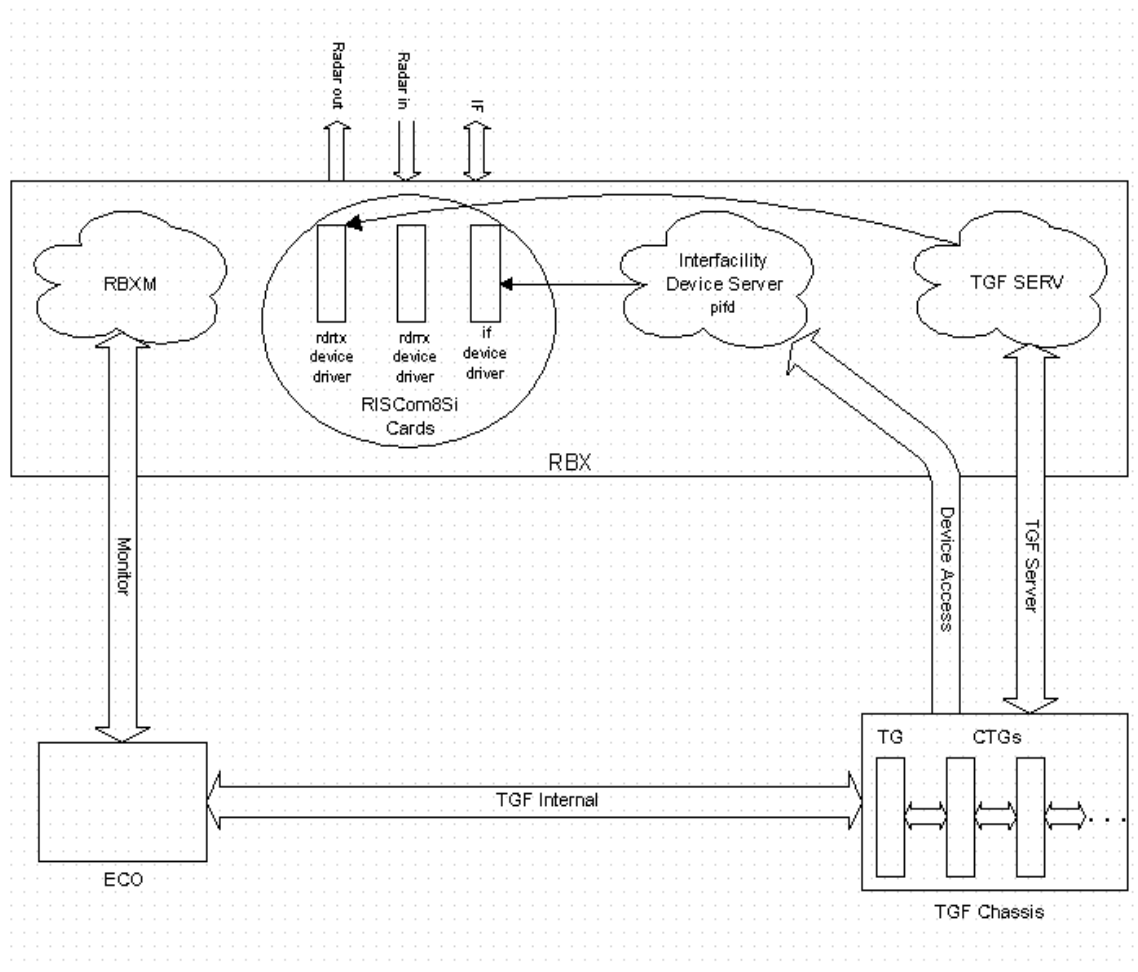


Figure 2-2 TGF to RBX Architectural Interface

2.3 RADAR BOX HARDWARE

Each RBX is a 120 Megahertz Pentium computer running the Linux operating system (version 2.0). These rack mounted PCs contain 2 Gigabytes of disk space connected to a high performance PCI SCSI controller as well as 32 Megabytes of RAM. A 3Com 10/100 ethernet network adapter running at 10 mbs provides network connectivity. SDL Communications' RISCom/8Si multi-port serial cards provide radar and interfacility functionality. See Appendix B for the base address, IRQ, and IO port settings for the RISCom/8Si serial boards. See Appendix C for more information on the specific components of the RBX computers.

The radar rack consists of multiple RBX computers mounted in a 19" rack cabinet with a monitor, keyboard, and mouse. A Raritan Master Console switch is used to connect these

peripherals to the multiple RBX computers. Breakout boxes for the RISCom/8Si serial boards are mounted in the rear of the radar rack to facilitate connectivity with the Bytex switch. Each breakout box consists of 8 DB-25 Male connectors; one for each serial port on a single RISCom/8Si. Custom cables are used to connect the radar rack to the Bytex. See Appendix D for the radar rack / Bytex cable pinouts. Network connectivity is provided by an SMC Ether EZ mini-hub.

Communication between the main TGF system and the RBX computers is provided by a 10 BaseT network. Category 5 cabling is used. The ethernet interface on the chassis is either provided on board the Heurikon Nitro60 Single Board Computers (SBC), or on board the Heurikon V30XE SBCs. The V30XE is used in the older TGF systems and the Nitro60 is used in the newer systems.

Figure 2-3 shows the Radar Rack containing three Radar Boxes.

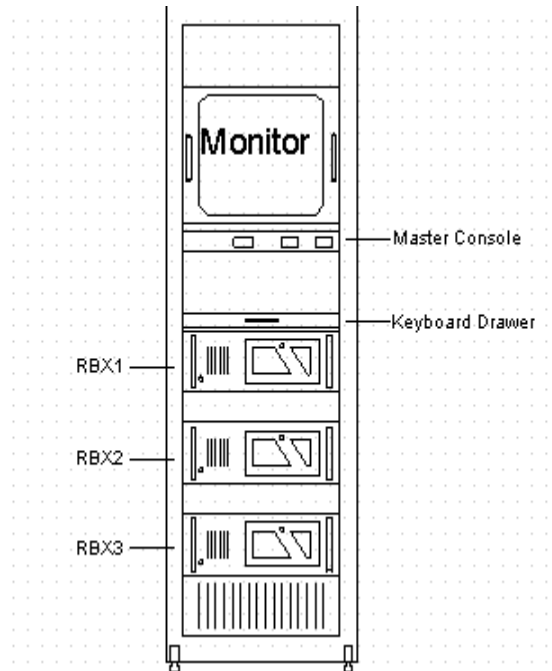


Figure 2-3 Radar Rack

3. RADAR BOX MONITOR INTERFACE PROTOCOL

The RBX monitor network protocol contains the configuration information for the devices that are built into the RBX. The following paragraphs describe the RBX monitor protocol, which defines the two packet types that can go over the network. Table 3-1 shows the enumeration of the packet types for the RBX monitor protocol. See Figure 4-1 and Figure 5-1 for the communication between the RBX monitor and a client.

Table 3-1 RBX Monitor Packet Type Enumeration

Packet Type	Abbreviation	Enumeration
Resource Availability Request	INFO_REQ	0
Resource Availability Response	INFO_RESP	1

3.1 RESOURCE AVAILABILITY REQUEST

A Resource Availability Request packet asks the RBX what devices it possesses and what the status is of each of these devices. On startup, the ECO sends a Resource Availability Request packet by UDP broadcast. Every RBX on the network sees the request and will issue a response. A request requires no additional information. Table 3-2 presents the format of the information included in a Resource Availability Request packet.

Table 3-2 Resource Availability Request Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	INFO_REQ

3.2 RESOURCE AVAILABILITY RESPONSE

A Resource Availability Response packet includes all the information about each of the devices on a particular RBX. The response packet is sent UDP unicast back to the requestor. This allows the requestor (ECO) to distinguish between those devices that are available and those that are already in use. A response will include the name, devices, and a device list. Table 3-3 presents the format of the information included in a Resource Availability Response packet

Table 3-3 RBX Resource Availability Response Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	INFO_RESP
Host Name	40	ASCII String	
Devices	4	Integer	
Device List	48	ASCII String	

3.2.1 Host Name

Host Name is a 40-byte ASCII character field used to identify the host that is responding.

3.2.2 Devices

Devices is an integer field that indicates the number of device lists that will follow in the packet.

3.2.3 Device List

The Device List contains the actual information about each device that an RBX computer possesses. The list will include the device name, device type, owner, card identifier, network port and a description. Table 3-4 presents the format of the information included in the Device List.

Table 3-4 Device List Information

Field	Length (Byte)	Format	Value
Device Name	12	ASCII String	
Device Type	4	Enumeration	IF, RDR_TX, or RDR_RX
Owner	4	Integer	
Card Identifier	4	Integer	
Network Port	4	Integer	
Description	20	ASCII String	

3.2.3.1 Device Name

The Device Name consists of a 12-byte ASCII character field used to uniquely identify each device.

3.2.3.2 Device Type

The Device Type is an enumerated integer field used to identify what the device can simulate. It will either indicate a radar transmitter, a radar receiver, or an IF connection. Table 3-5 presents the enumeration of the types of devices.

Table 3-5 Device Types

Device Type	Abbreviation	Enumeration
Interfacility	IF	0
Radar Transmitter	RDR_TX	1
Radar Receiver	RDR_RX	2

3.2.3.3 Owner

The Owner is an integer field that indicates if a device is being used or if it is available. A zero indicates that it is available and any other integer indicates it is in use. If a device is being used, the number identifies the owner. A relatively low number, between 1 and 100, probably indicates that a Chassis is using the device and that number identifies the Chassis. A large number indicates that a program is using the device and that number identifies the process ID of the program.

3.2.3.4 Card Identifier

Each RBX can contain up to three SI8 cards. Each SI8 card may have two radar transmitter devices, two radar receiver devices, or eight IF devices. The devices on each card must all be the same. Each card has a different IO Port, an arbitrary value, which can be used to identify the cards. See Appendix B for the IO Port settings of the physical cards.

3.2.3.5 Network Port

The Network Port field identifies which port is used to access a device on the network. It provides the interface to the local area network. This field is currently unused.

3.2.3.6 Description

The Description field is a logical name for the machine and the device. It identifies a particular device and which machine it is on. For example, rbx1-rx0 refers to radar receiver 0 on radar box 1. By convention, the Description also identifies on which ports the data will be located on the Bytex.

4. DEVICE ACCESS SERVER PROTOCOL

The RBX Device Access Servers are the services available on the RBX that anyone can access through the network. The three different types of devices that are accessible through the RBX are radar transmitters, radar receivers and IF. Radar transmitters and receivers can only send radar or receive radar, while IF can communicate in both directions. A radar transmitter receives radar from the Chassis and sends it out like actual radar. A radar receiver receives radar from the Bytex and puts the information into a readable form so that the radar can be monitored. An IF device can transmit and receive radar at the same time. The following is a description of the Device Access protocol, which defines the operations that can be performed on the three devices. These operations include device open, device open reply, device close, device data, and device IO control (IOCTL). All devices are accessed using UDP unicast packets. The first piece of information in each of these packets is an enumerated integer field that identifies the type of packet that is being sent. Table 4-1 shows the enumeration of the packet types for the device access server protocol. See Figure 4-1 for the communication between the radar receiver and a client.

Table 4-1 Device Access Server Packet Type Enumeration

Packet Type	Abbreviation	Enumeration
Device Open	DEV_OPEN	0
Device Open Reply	DEV_OPEN_REPLY	1
Device Close	DEV_CLOSE	2
Device Data	DEV_DATA	3
Device I/O CONTROL	DEV_IOCTL	4

4.1 DEVICE OPEN

A device is opened after the server receives a packet requesting the device. A device open can be issued by anyone who wishes to open a connection to an RBX and reserve a device. This is required prior to the start of data packet transmission. The packet includes the name of the device to be opened. Table 4-2 presents the format of the information included in the Device Open packet.

Table 4-2 Device Open Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	DEV_OPEN
Device Name	12	ASCII String	

4.1.1 Device Name

Device Name is a 12-byte ASCII character field that is used to identify the name of the device to be opened. The Device Name will be in one of the following formats:

- rdrtnN
- rrrxnN
- ifN

The ‘N’ represents an integer between zero and the number of devices that exist.

4.2 DEVICE OPEN REPLY

After the RBX has attempted to open a device that has been requested, it sends a reply back to the machine that sent the open request with the results of the attempt to open the device. The packet includes the name of the device, the status of the device and possibly an error message. Table 4-3 presents the format of the information included in the Device Open Reply packet.

Table 4-3 Device Open Reply Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	DEV_OPEN_REPLY
Device Name	12	ASCII String	
Status	4	Integer	
Error Message	Varied	ASCII String	

4.2.1 Device Name

The Device Name is a 12-byte ASCII character field used to identify the device that the RBX attempted to open. The Device Name will be in one of the following formats:

- rdrtxN
- rdrrxN
- ifN

The 'N' represents an integer between zero and the number of devices that exist.

4.2.2 Status

The Status is an integer field that gives the results of the attempt to open the device. The status of the device will be zero if the RBX was able to open it. If the device could not be opened the status will be the error number returned by the operating system.

4.2.3 Error Message

An Error Message is included in the packet to explain why a device could not be opened. It is a null terminated ASCII string of variable length. The message is the standard error string for the particular status that is given.

4.3 DEVICE CLOSE

A device should be closed when the device is no longer required, i.e., at the end of a simulation. The packet contains a field to identify the name of the device to be closed. Table 4-4 presents the format of the information included in the Device Close packet.

Table 4-4 Device Close Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	DEV_CLOSE
Device Name	12	ASCII String	

4.3.1 Device Name

Device Name is a 12-byte ASCII character field used to identify the name of the device to be closed. The Device Name will be in one of the following formats:

- rdrtxN
- rdrrxN
- ifN

The 'N' represents an integer between zero and the number of devices that exist.

4.4 DEVICE DATA

After a start has been issued, data packets are passed to the RBX from the Chassis. The data that is passed to the Radar Servers is different than the data that is passed to the IF Server.

4.4.1 Radar Device Data Packets

Radar receiver devices provide radar data from sources connected to the Bytex to any client that connects to it. A device Open / Device Open Reply transaction must successfully take place before Device Data packets can be received. The radar data type defaults to long range radar; short range must be specified if it is desired. A Start must be issued in order to receive radar data packets.

When the device is a radar transmitter, a similar process occurs. A Device Open must be sent and then a Device Open Reply should be received. When a start is issued, the Chassis begins sending data packets to the RBX, which reformats the data and transmits it as actual radar to the Bytex.

Table 4-5 presents the format of the data that can be both sent and received in the Device Data packets to the Radar Servers. All fields prior to the Data field are considered the header of the Data Packet.

Table 4-5 Radar Device Data Packet

Field	Length (Byte)	Format	Value
Channel	1	Integer	'0', '1', '2', '3'
Type	4	Enumeration	
Flags	1	Bit Field	
Time	4	Integer	1/100 seconds
Size	1	Integer	
Data	64	Binary	

4.4.1.1 Channel

The Channel field is a 1 byte integer that indicates, for a radar transmitter, on which radar channel to transmit data. There are four channels on each RBX card. A zero in this field indicates that any channel may be used. For a radar receiver, this field indicates on which channel the data was received.

4.4.1.2 Type

The Type is 1 byte that identifies the type of the message. The following is a list of the different types of radar messages that may be received or transmitted.

- Search
- Strobe
- Beacon
- Status
- Beacon Reinforced
- Search Real Time Quality Control (RTQC)
- HGT
- Beacon RTQC
- Sector Mark (SM)
- ASR9 - Terminal
- Scip Control
- LD2 - Enroute Weather (MAP)

4.4.1.3 Flags

Flags is a bit field that is used to indicate errors. When an error occurs a bit is set that represents a particular error. The three types of errors that may arise are Malfunction errors, Invalid Header errors, and Synchronization errors. Bits 0, 1, and 2 represent them, respectively.

4.4.1.4 Time

The Time is a 4 byte integer that indicates the simulation time in hundredths of seconds.

4.4.1.5 Size

The Size is 1 byte that indicates the size of the message in the Data section. The size is given as the number of 16 bit words that are significant and should be read from the data. Each 16 bit word contains a 12 bit radar word pre-padded with 4 bits.

4.4.1.6 Data

The Data is 32 2-byte words containing specific information for the message depending on the type of message being received. Only the first number of words given by Size contain valid Data. The least significant 12 bits of each two byte word contain the actual radar data. The following is a description of the types of messages that could be passed, including Aircraft information, Sector Marks, Real Time Quality Control (RTQC), or Weather information. This Data is the raw radar data. For Enroute the format will be CD2 and for terminal it will be ASR9. See Appendix F for the CD2 format. The following are the CD2 messages supported by TGF.

- Map
- Search
- Search RTQC
- Beacon
- Strobe •Status

4.4.1.6.1 Aircraft

An Aircraft message includes the range and azimuth. The slant range indicates the distance from the radar to the target. The azimuth is the number of Azimuth Change Pulses (ACP) the radar has rotated through to detect a target. The message may also include the beacon code and the altitude of the aircraft.

4.4.1.6.2 Sector Marks

A Sector Mark message indicates the number of the subsector sent for ASR9 radars only.

4.4.1.6.3 Real Time Quality Control (RTQC)

RTQC messages are used to determine if there is a problem with the radar. A problem may be detected if there is a change in the fixed target that the radar generates.

4.4.1.6.4 Weather

A Weather message shows how dense the weather is at a particular location.

4.4.2 IF Device Data Packets

The IF device is able to communicate with the TG Chassis to transmit and receive radar. The TG Chassis, acting as the client, needs to establish a TCP/IP socket for communication with the IF device. Once a connection is established they can exchange data packets. The format of the data packets is the same traveling in both directions.

An IF Device Data packet includes the packet type, IF message type, error flags, size, a timestamp, and IF data. Table 4-6 presents the format of the information sent and received in the Device Data packets to the IF Server.

Table 4-6 IF Device Data Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	IF_MSG
Message Type	1	Enumeration	
Flags	1	Bit Field	
Size	2	Short Integer	
Time	8	Long Integer	
Data	248	EBCDIC	

4.4.2.1 Message Type

The Message Type is an enumerated integer field that indicates what type of IF message is being sent or received.

4.4.2.2 Flags

Flags is a bit field that is used to indicate errors. When an error occurs a bit is set that represents a particular error. The three types of errors that may arise are parity errors, LRC errors, and no end of message errors represented by bits 0, 1, and 3, respectively.

4.4.2.3 Size

The Size field is a short integer that indicates the size of the IF message that is valid.

4.4.2.4 Time

The Time field indicates the simulation time in hundredths of seconds.

4.4.2.5 Data

The Data field contains the exact data that is being exchanged between and IF systems. The maximum size of the message is 248 bytes. The format of the data is EBCDIC. See Appendix A of the NAS-MD-640 document for the IF message formats.

4.5 DEVICE I/O CONTROL (IOCTL)

The IOCTL packet contains miscellaneous information that is used to set up and control the devices. There are different IOCTL messages for radar and IF communication. Table 4-7 shows the enumeration and arguments of the IOCTL messages.

Table 4-7 Device IOCTL Enumeration

Message Type	Radar/IF	Enumeration	Argument
Start	Radar/IF	2	Simulation time
Transmitter Clock	IF	4	Baud rate (0 = external clock)
Receiver Clock	IF	5	Baud rate (0 = external clock)
Invert	Radar	6	
Physical Interface	Radar	7	0 = RS-232, 1 = RS-422
Receiver Clock	Radar	8	Baud rate (0 = external clock)
Setowner	Radar/IF	10	Chassis number

4.5.1 Radar IOCTL Messages

The following is a description of the different types of messages that a Radar IOCTL packet can include.

4.5.1.1 Start

The Start message sets the clock and allows data packet transmission.

4.5.1.2 Invert

The Invert message changes the polarity of the data.

4.5.1.3 Physical Interface

The Physical Interface message toggles the physical data between balanced and unbalanced. Normally short range radar is balanced, RS-422, and long range radar is unbalanced, RS-232. The TGF sends all radar RS-232 and the Bytex handles the conversion to RS-422 for short range.

4.5.1.4 Receiver Clock

The receiver message sets the baud rate of the radar receiver's clock. The normal default is zero, which allows the radar to accept an external clock. If the clock is set, the baud rate for the line is generated internally.

4.5.1.5 Setowner

The Setowner message is used to configure the device and report the current owner. The default owner is the process id.

4.5.2 Interfacility (IF) IOCTL Messages

The following is a description of the different types of messages that an IF IOCTL packet can include.

4.5.2.1 Start

The Start message sets the clock and allows packets of data to begin being passed.

4.5.2.2 Receiver Clock

The receiver clock message sets the rate of the IF clock.

4.5.2.3 Transmitter Clock

The transmitter clock message sets the rate of the IF clock.

4.5.2.4 Setowner

The final information in the packet is called setowner and is used to configure the device and report the current owner. The default owner is the process id.

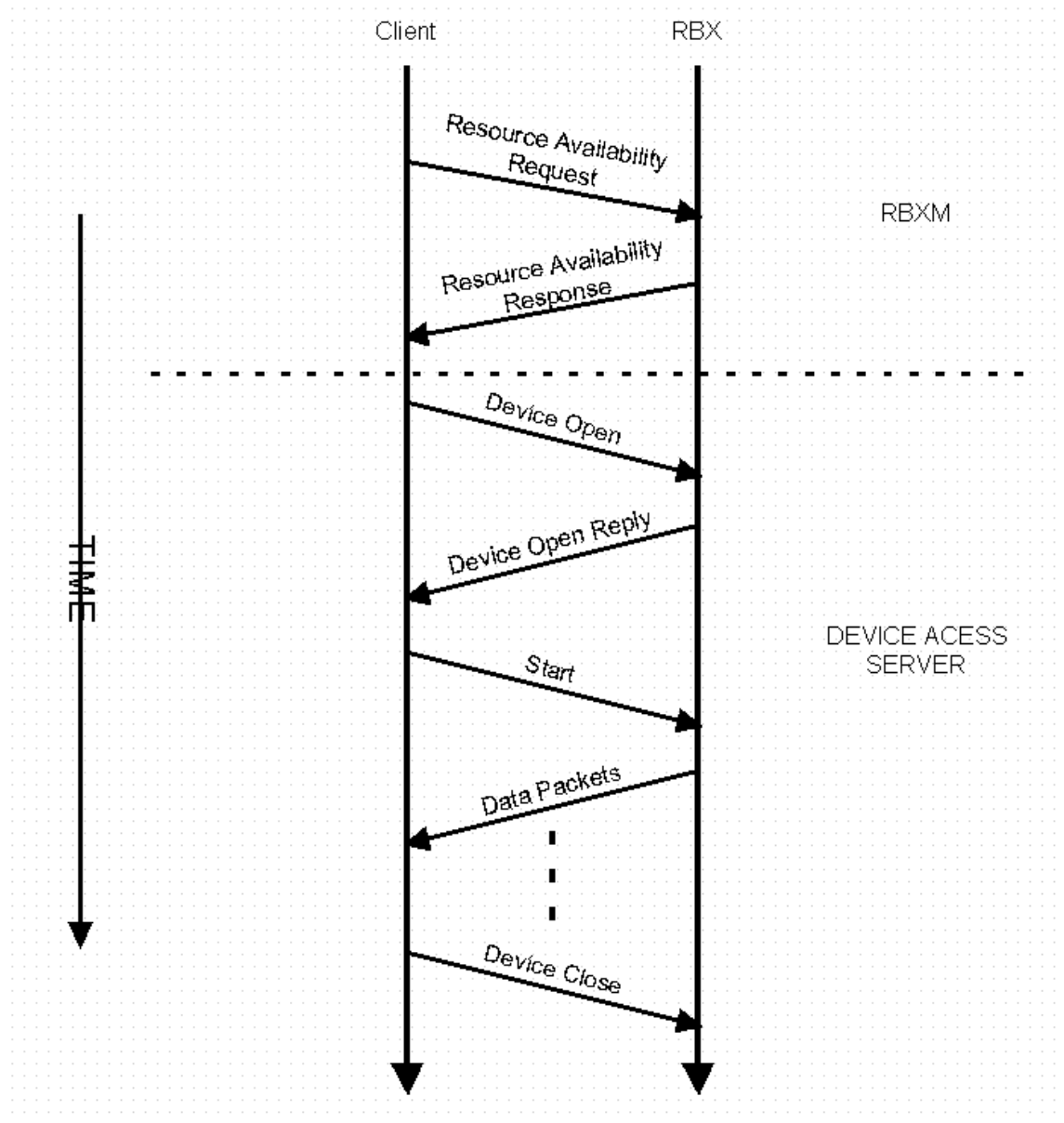


Figure 4-1 Radar Receiver Communication

5. TARGET GENERATOR FACILITY SERVER PROTOCOL

The TGF Server is a daemon process, which runs on the RBX to handle radar transmission for the TGF Chassis. The TGF Server receives target reply blocks from the various processes running on the TGF Chassis. The TGF Server combines these blocks into a single time sorted message queue for each radar. The following paragraphs describe the TGF Server protocol, which defines the packet types that can go over the network. The first piece of information in each packet is an enumerated integer field that identifies the type of packet being sent. Table 5-1 shows the enumeration of the packet types for the TGF server protocol. See Figure 5-1 for the communication between a radar transmitter, the ECO, and the Chassis.

Table 5-1 TGF Server Packet Type Enumeration

Packet Type	Abbreviation	Enumeration
TGF Open Request	TGF_OPEN	0
TGF Open Reply	TGF_OPEN_REPLY	1
TGF Data	TGF_DATA	2
TGF Close	TGF_CLOSE	3
TGF Start	TGF_START	4
TGF Stop	TGF_STOP	5
TGF Pause	TGF_PAUSE	6
TGF End-of-Epoch	TGF_END_OF_EPOCH	7

5.1 SPECIFIC RADAR PACKETS

The following packet types are addressed to a particular radar and are sent UDP unicast.

5.1.1 TGF Open Request

The Open Request allows a Chassis to open and reserve a radar transmitter for use. One request per radar is sent, prior to the start of data packet transmission, until all the desired devices are open. This packet includes the name of the radar, the name of the device, the type of radar and the scan time. Table 5-2 presents the format of the information included in an open request packet.

Table 5-2 TGF Open Request Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_OPEN
Radar Name	12	ASCII String	
Device Name	20	ASCII String	
Radar Type	4	Integer	
Scan Rate	4	Integer	1/100 seconds

5.1.1.1 Radar Name

The Radar Name is a 12-byte ASCII character field used to uniquely identify the radar.

Examples: "BAL", "DFW"

5.1.1.1.2 Device Name

The Device Name is a 20-byte ASCII character field used to uniquely identify the device that is to be opened. The Device Name will be in one of the following formats:

- rdrtxN
- rdrrxN
- ifN

The 'N' represents an integer between zero and the number of devices that exist.

5.1.1.3 Radar Type

The Radar Type is an integer field that identifies whether the radar is a transmitter, receiver, or IF. The TGF Chassis will use a transmitter for radar output.

5.1.1.4 Scan Rate

The Scan Rate is an integer field that represents the time in hundredths of a second that is required for one complete radar rotation.

5.1.2 TGF Open Reply

The TFG Server sends one Open Reply to the requestor for each connection that the RBX attempted to open. The requestor IP address is obtained from the UDP header. The Open Reply packet includes the status of the device, the radar name and any error messages. Table 5-3 presents the format of the information in the Open Reply packet.

Table 5-3 TGF Open Reply Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_OPEN_REPLY
Status	4	Integer	
Radar Name	12	ASCII String	
Error Message	Varied	ASCII String	

5.1.2.1 Status

The Status is an integer field that signifies whether the device was successfully opened or not. The status is zero if the device was opened and less than zero if it could not be opened.

5.1.2.2 Radar Name

The Radar Name is a 12-byte ASCII character field that identifies which radar the RBX attempted to open.

5.1.2.3 Error Message

The Error Message field contains a message that explains why a device could not be opened. It is a null terminated ASCII string of variable length.

5.1.3 TGF Data

The TGF Chassis uses the TGF Data packet to transmit radar data through the RBX for each radar being simulated. This packet includes the name of the radar, the number of target reports, and messages. Table 5-4 presents the format of the information in the TGF data packets.

Table 5-4 TGF Data Packet

Field	Length (Byte)	Format	Value
Radar Name	12	ASCII String	
Target Reports	4	Integer	
Messages	72	ASCII String	

5.1.3.1 Radar Name

The Radar Name is a 12-byte ASCII character field that identifies the radar to which the message is being sent.

5.1.3.2 Target Reports

The Target Reports is an integer field that indicates the number of radar messages that are included in one packet.

5.1.3.3 Messages

The Message field is actually an array of radar messages. The Target Reports field indicates the number of messages that are contained in the Messages packet. Each message has a header followed by the data. The header includes a time stamp and the type of message that is being sent to the radar. The actual data is the same as that in a Device Data Packet. See section 4.4 for a complete description of the information contained in a data packet. Table 5-5 presents the format of the information included in the header of the message.

Table 5-5 TGF Message Header

Field	Length (Byte)	Format	Value
Message Type	4	Enumeration	
Time	4	Integer	1/100 seconds

5.1.3.3.1 Message Type

Message Type is an enumerated integer field that indicates the type of message that is being sent to the radar.

5.1.3.3.2 Time

The Time is an integer field that indicates the simulation time in hundredths of seconds.

5.1.4 TGF Close

The TGF Close packet contains the name of the device that is going to be closed. The TGF Close message tells the TGF Server to deallocate all resources for that radar. If the TGF Server has no more open radars, it will exit. Table 5-6 presents the format of the information included in the TGF Close packet.

Table 5-6 TGF Close Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_CLOSE
Device Name	20	ASCII String	

5.1.4.1 Device Name

Device Name is a 20-byte ASCII character field that is used to identify the name of the device that is going to be closed. The Device Name will be in one of the following formats:

- rdrtxN
- rdrrxN
- ifN

The 'N' represents an integer between zero and the number of devices that exist.

5.2 GLOBAL PACKETS

Global packets are used by the TGF Server for administration and control. The following Global packets apply to all radars and are sent UDP broadcast.

5.2.1 TGF Start

A Start packet is sent out to all radars at once to begin a simulation. The packet contains one field that gives the time in hundredths of seconds. Every minute the TGF Chassis sends a start containing this time stamp to maintain synchronization. Table 5-7 presents the format of the information included in the TGF Start packet.

Table 5-7 TGF Start Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_START
Time	4	Integer	1/100 seconds

5.2.1.1 Time

Time is an integer field that indicates the simulation time in hundredths of seconds.

5.2.2 TGF Stop

A Stop packet is sent to all radars at once to end the simulation. The packet does not contain any additional data. Table 5-8 presents the format of the information included in the TGF Stop packet.

Table 5-8 TGF Stop Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_STOP

5.2.3 TGF Pause

A Pause packet is sent to all radars at once to freeze the simulation. The packet does not contain any additional information. Table 5-9 presents the format of the information included in the TGF Pause packet.

Table 5-9 TGF Pause Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_PAUSE

5.2.4 TGF End-of-Epoch

An End-of-Epoch packet is sent to the TGF Servers once per second. Each end-of-epoch packet carries a time stamp that gives the time in hundredths of seconds. At every end-of-epoch, the RBX flushes all the information in its master list up to the time stamp given by the end-of-epoch. Table 5-10 presents the format of the information included in the TGF End-of-Epoch packet.

Table 5-10 TGF End-of-Epoch Packet

Field	Length (Byte)	Format	Value
Packet Type	4	Enumeration	TGF_END_OF_EPOCH
Time	4	Integer	1/100 seconds

5.2.4.1 Time

Time is an integer field that indicates the simulation time in hundredths of seconds.

Radar Transmitter Communication

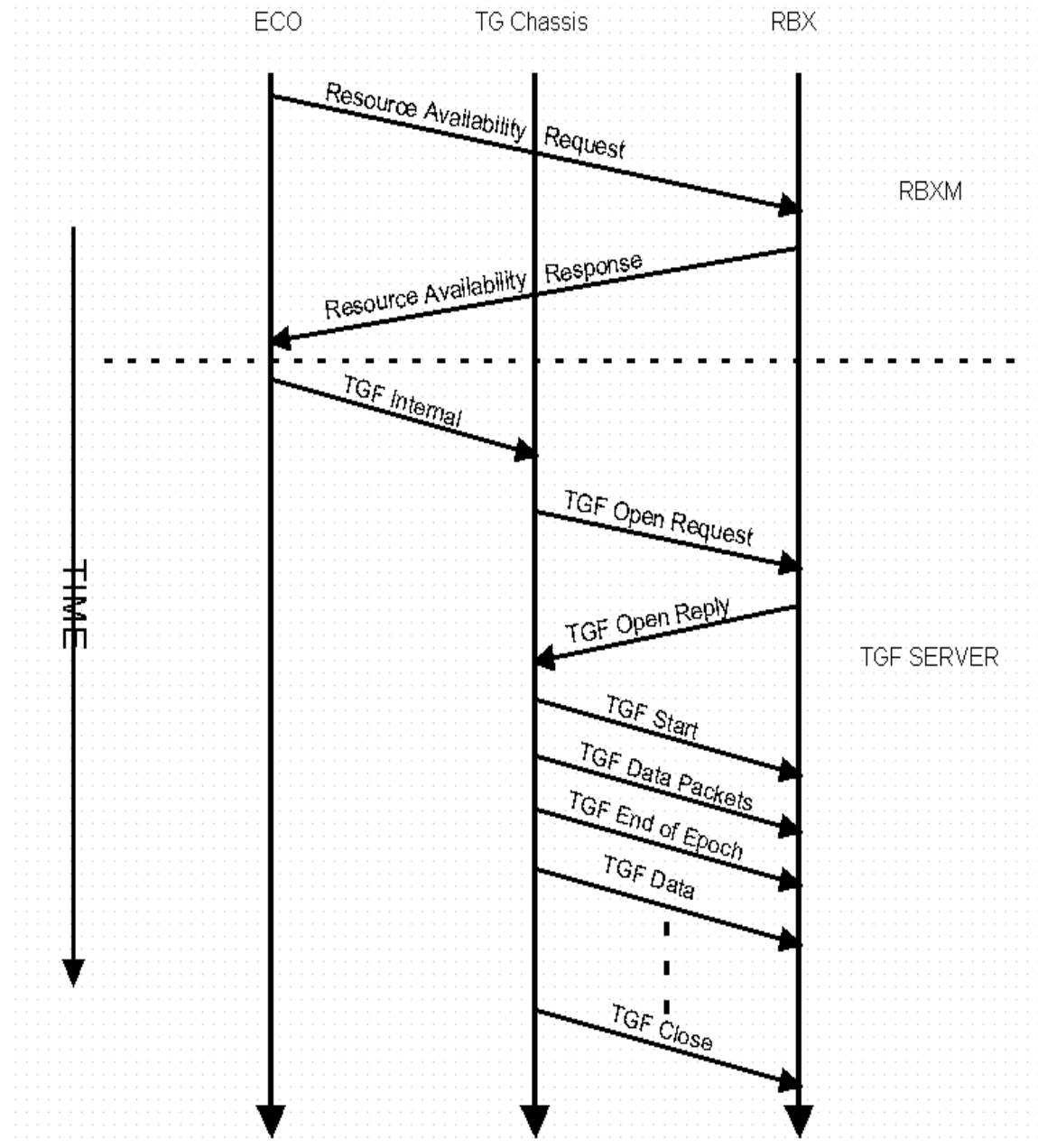


Figure 5-1

Radar Transmitter Communication

APPENDIX

APPENDIX A – Acronym List

AAS	Advanced Automation System
ACP	Azimuth Change Pulses
ATC	Air Traffic Control
CTG	Core Target Generator
ECO	Exercise Control Operator
ECW	Exercise Control Workstation
FAA Technical Center	Federal Aviation Administration Technical Center
ICD	Interface Control Document
IF	Interfacility
IOCTL	Input / Output Control
IP	Internet Protocol
IRQ	Interrupt Request
OT&E	Operational Test and Evaluation
PCI	Peripheral Component Interconnect
PIFD	Pseudo Interfacility Device
PRDRRXD	Pseudo Radar Receiver Device
PRDRTXD	Pseudo Radar Transmitter Device
R&D	Research and Development

RBX	Radar Box
RBXM	Radar Box Monitor
RTQC	Real Time Quality Control
SBC	Single Board Computer
SCSI	Small Computer Systems Interface
TCP	Transmission Control Protocol
TGE	Target Generator Executive
TGF	Target Generation Facility
UDP	User Datagram Protocol

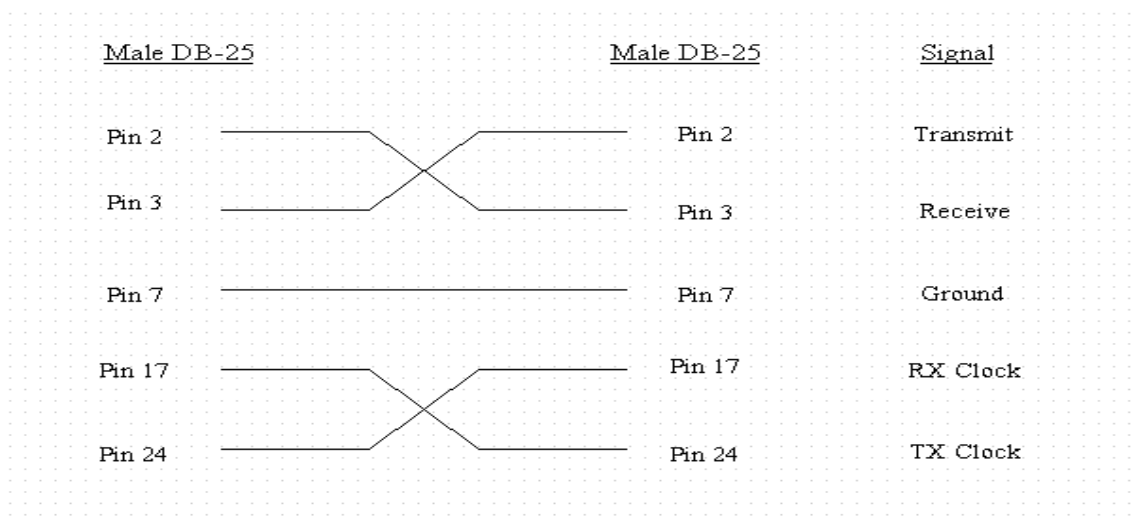
APPENDIX B – RISCom/8Si Base Address, IRQ, and IO Port Settings

	<u>BASE ADDRESS</u>	<u>IRQ</u>	<u>IO PORT</u>
Card 1	0xD0	None	0x240
Card 2	0xD4	None	0x260
Card 3	0xD8	None	0x2B0

APPENDIX C – Specific RBX Components

Motherboard	Asus Motherboard
Processor	Pentium 120MHZ Microprocessor w/ fan
DRAM	32 Meg RAM
RAM Cache	Internal Cache on CPU
Hard Disk	Seagate ST32155N 2 gig hard disk
Controller Card	Adaptec 2940U PCI SCSI
Video Card	Diamond PCI Video
Network Option	3Com EC905 10/100 Fast Ethernet PCI Adapter
System Software	Linux 2.0 (Unix for Intel)
Enclosure	Silicon Rax SRPC – 210
Serial Interface	S18 Serial Boards

APPENDIX D – RBX/Bytex Cable Pinouts



APPENDIX E – UDP/TCP Port Assignments

Process/Machine	Port Number	UDP/TCP
RBXM Monitor	6000	UDP
PRDRTXD	6001	UDP
PIFD	7000	UDP
PRDRRXD	8000	UDP
TGF Server	9050 + Chassis number	UDP

APPENDIX F – CD2 Format

APPENDIX G – Header File Summaries

Each of the following header files is located in the `tgf/include` directory.

- **dev_rbx.h** This header file provides the high level interface between the TGF and RBX.
- **tgf_rbx.h** This header file provides a more detailed interface between the TGF and RBX.
- **if.h** This header file contains the message format for interfacility communication.
- **ifmsgs.h** This header file is the wrapper between the IF Device Server and the TGF.